SQUINT

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SQUINT

Its Etiology, Diagnosis and Treatment

by

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EDITOR'S NOTE

It has been several years since Dr. Todd compiled the original set of A. O. A. study courses. These courses have certainly filled an obvious need. Yet there are optometric subjects for which there has been an ever increasing demand, nor is it to be inferred that the original set was intended to meet all optometric needs.

This little volume, concise and yet complete, is an effort to deliver to optometrists a text on one of the subjects for which a demand has been demonstrated. In selecting Morgan C. Davies, instructor in optometric subjects at Ohio State University, to prepare this text there were two controlling factors: First, his connection with the university, even back to the time when the illustrious Sheard was head of the Department of Applied Optics, and a teaching experience which has enabled the author to develop a technique of presentation of his subject which carries the thought complete to his hearers and readers; and second, his extensive experience in the clinic at Ohio State University, which has served to teach many truths in the hard school of experience.

It had been intended to present some half-tone photographs of cases, but the author thought best, because of the difficulty of securing just the correct photographic effect, to confine the illustrations to line drawings which would not admit of any misinterpretation, and at the same time present a clearer mental picture.

The editor feels assured that after a close study of the monograph herein contained, with whatever collateral reading may be done, the reader will have acquired a mental grasp of that most difficult subject of Squint, which will enable him to deliver a much more proficient service to his patients.

H. RILEY SPITLER, Editor.

FOREWORD

In this monograph, the writer has attempted to include all that is essential in the optometric treatment of squint. The reader is assumed to be thoroughly proficient in skiametry, without which proficiency no attempt toward the treatment of squint should be made

Most of that which follows is the result of ten years' experience in clinical experimentation. The standard texts have been freely consulted and in addition, the writings of Cross, Bestor and Sheard on Dynamic Skiametry and Higley on Cross Eyes have been examined in particular.

No attempt is made to force unsupported theories upon the reader and the facts herein presented are accepted by competent practitioners everywhere.

Thanks is also due to H. Riley Spitler, whose generosity has made the work possible.

MORGAN C. DAVIES.

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SECTION I.

Definitions and Classification of Squint

1. Squint is that condition in which the visual axis of one eye is deviated from the point of fixation.

   (a) Synonyms: Heterotropia, Crossed Eyes, Strabismus, Manifest Squint.

2. The fixing eye is understood to be the one whose macula receives the rays from the object fixated.

3. The deviating eye is the one which receives rays from the object being fixated, extra-macularly.

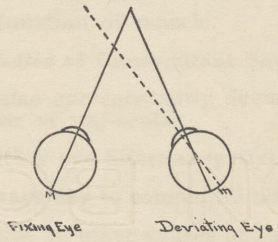


Fig. 1

4. Primary deviation is the deviation from the fixation point of the visual axis of the squinting eye.

5. Secondary deviation is the deviation from the fixation point of the visual axis of the fixing eye when occluded by a screen. (If either eye will fix without occlusion, it is immaterial to which eye the terms are applied).

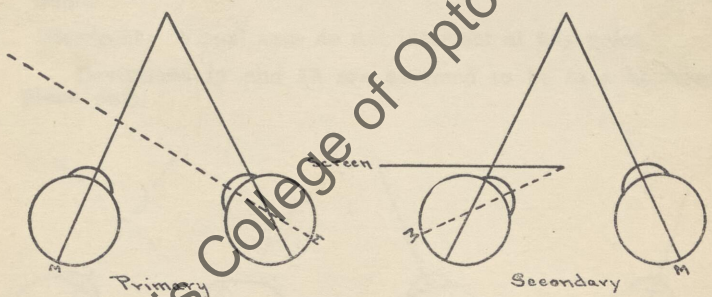


Fig. 2

Divisions of Squint

6. Concomitant: Deviation persists no matter how eyes are rotated and is always same degree from correct position.

7. Paralytic: Deviation varies depending upon direction of rotation, deviation less as eyes are turned away from affected muscle.

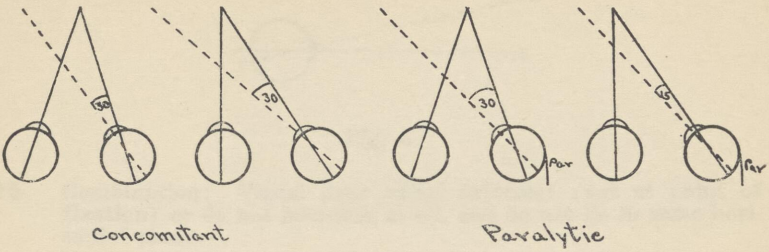


Fig. 3

(a) Paralysis: Complete suspension of function of muscle.

(b) Impaired function of muscle.

Varieties of Concomitant Squint

8. Monolateral: Same eye constantly deviates. Also called unilateral, monocular or uni-ocular.

9. Alternating: Either eye alternately fixes and deviates.

(a) **True** is always due to congenital absence of fusion sense.

(b) **Psuedo** is due to other causes of squint.

10. Constant: When the deviation is always present, also called fixed or absolute.

11. Periodic: When the deviation is not always present, also called relative, intermittent, occasional or recurrent.

Types

12. Convergent: Visual axes intersect but not at the fixation point.

13. Divergent: Visual axes do not intersect at any point.

Deviations 12 and 13 are assumed to be in a horizontal plane only.

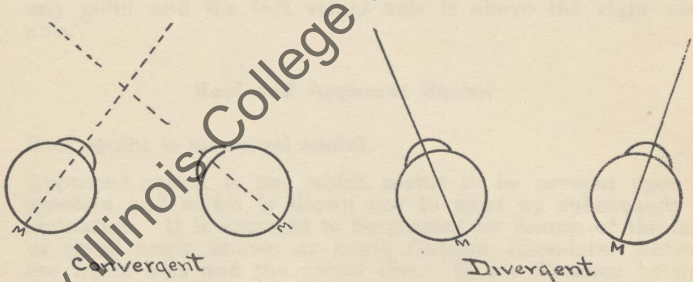


Fig. 4

14. **Vertical:** Visual axes do not lie in same horizontal plane.

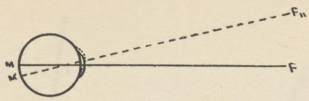


Fig. 5

15. Combination: Visual axes either intersect (not at point of fixation) or do not intersect at all, and do not lie in same horizontal plane.

According to Stevens, Types of Squint Are Arranged as Follows:

16. Esotropia: Visual axes intersect but not at point of fixation.

17. Exotropia: Visual axes do not intersect.
Both 16 and 17 lie in same horizontal plane.

18. Hypertropia: One visual axis points above the other.

(a) Rt. Hypertropia: Right visual axis above left.

(b) Lt. Hypertropia: Left visual axis above right.

19. Hypotropia: One visual axis points below the other.

(a) Rt. Hypotropia: Right visual axis below left.

(b) Lt. Hypotropia: Left visual axis below right.

Note: It will be readily apparent that 19 is not needed since Rt. Hypertropia is Left Hypotropia and vice versa.

20. Right Hyperesotropia: One visual axis intersects the other, but within the fixation distance and the right visual axis is above the left visual axis.

21. Left Hyperesotropia: One visual axis intersects the other, but within the fixation distance and the left visual axis is above the right visual axis.

22. Right Hyperexotropia: The visual axes do not intersect at any point and the right visual axis is above the left visual axis.

23. Left Hyperexotropia: The visual axes do not intersect at any point and the left visual axis is above the right visual axis.

Real and Apparent Squint

24. Real squint is an actual squint.

25. Apparent squint is one which seems to be present upon inspection and which is shown not to exist by subsequent examination. It is assumed to be present by reason of the large or small angle known as angle Gamma (Donders) between the Optic axis and the visual line. If the distance between the posterior pole and the macula is large, the angle is large and vice versa. We do not see the angle but only its manifestation as the following diagram will show. If the angle is negative the posterior pole may be temporal with respect to the macula.

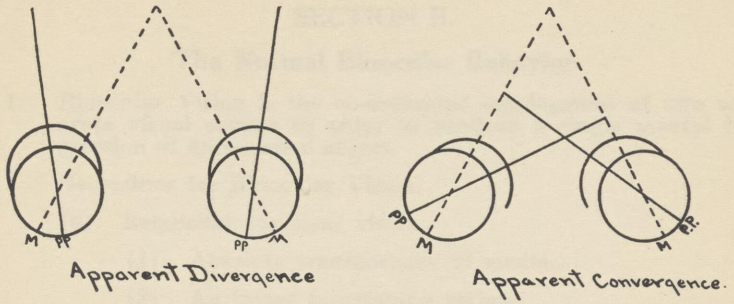


Fig. 6

26. Paralytic Squint results from suspension of or impaired function of one or more of the six extra-ocular muscles. Its causes are pathological and numerous. It has no place in a discussion of this nature and will not be considered except in the differential diagnosis of squint, where its exclusion is vital.

END OF SECTION I.

SECTION II.

The Normal Binocular Behavior

1. Binocular Vision is the co-ordinated employment of two separate visual organs in order to produce a single mental impression of an external object.

2. Necessities for Binocular Vision.

   (a) Requisites for clear vision.

      (1) Absolute transparency of media.

      (2) An intact functioning retina.

      (3) Perfect transmission to visual center in cerebral cortex.

      (4) Proper functioning of this center.

      (5) Object viewed and retina conjugate.

   (b) Visual fields, both central and peripheral must overlap.

   (c) Approximately similar images must be formed on the retina.

   (d) The retina must possess physiologically corresponding points in order that similar images formed on them may produce one conscious impression.

   (e) The external eye muscles must so adjust the visual axes that the centers of the fields of the two eyes coincide with the images of one and the same object. This adjustment is called fixation.

   (f) The oblique muscles must rotate the eyes about their axes until corresponding retinal points occupy corresponding meridians. This is a reflex process.

3. It is obvious that any factor which interferes with clear vision is a potential source of squint. So that no further discussion of the requisites for clear vision is necessary. The visual fields are governed by the muscular action and the bony prominences of the face. A schematic figure of the overlapping fields is shown. This should not be confused with the binocular field of fusion.

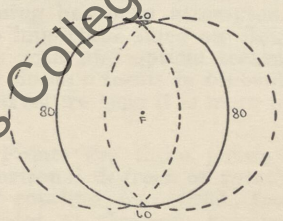


Fig. 7

4. Similar Images: It is well known that equal images, (size and shape) are fused although vision may be poor. These patients if hyperopic are not often squinters. The writer has had two

cases of high Hyperopia, twelve dioptres in a child of five, and nine dioptres in a man of thirty-five, neither of whom presented manifest squint. While on the other hand a great many squint cases present marked anisometropia.

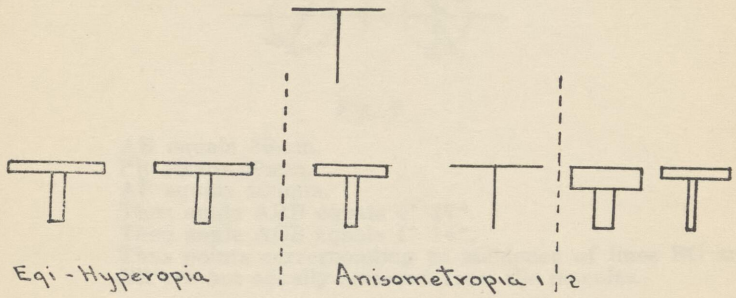


Fig. 8

It is readily apparent that the retinal images in **a** will fuse, **b** may, while **c** will not. Probably the dissimilarity of retinal images is one of the most important factors in the production of squint. This dissimilarity between images results in antagonism and so called binocular rivalry. First one image presenting to consciousness and then the other. Finally the image representing the least ocular effort is chosen and by some means which we call mental suppression the other does not stimulate sufficiently to penetrate consciousness. If macular vision is one hundred percent., it has been estimated that vision two degrees away from the macula is less than ten percent. Thus rotation of one eye two degrees would so reduce the sharpness of the image in comparison with that of the other eye, that its image is easily ignored. This squint is not easily recognized by inspection but requires more delicate means of diagnosis, i. e., corneal images. In correcting these cases the lenses should be placed in the anterior focal planes, but this would require the stronger lens in advance of the other and is objectionable cosmetically, nevertheless the writer believes his success has been more marked when this has been done. The exact position of course is difficult to determine so that only relative positioning has been attempted. The images in myopia are not so important since an elongated eye moves with difficulty in its orbit and optical treatment, if the myopia is marked, usually doesn't result in binocular vision. If the myopia is of the curvature type it is more amenable to treatment.

5. Corresponding Points are those points on the retinas which answer to proportional degrees of rotations of the eyes about their centers of rotation, and which, from given points in the plane of the point of fixation, receive incident rays which must pass through the nodal points. They represent, therefore, the relation between the muscular and retinal senses. (Motor Apparatus of Eyes—Stevens). It is readily proved that corresponding retinal points do not correspond geometrically or anatomically.

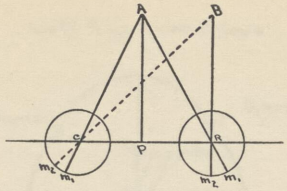
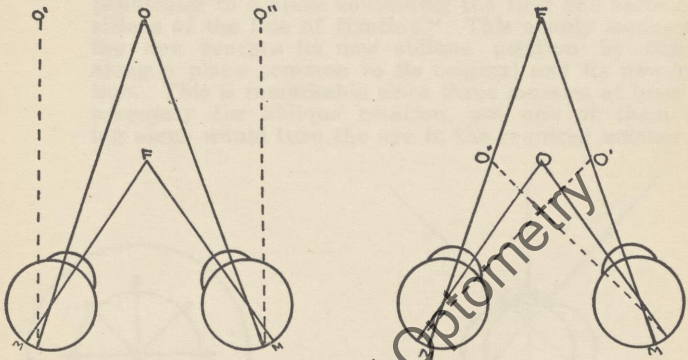


Fig. 9

AB equals 30mm.
PR equals 30mm.
AP equals 400mm.
Then angle ARB equals 4° 17".
Then angle ACB equals 4° 14".
Thus points corresponding to incidence of lines BC and BR are not equally removed from the maculas.

Further it has long been known that if the eyes fix upon a point for points beyond, homonymous diplopia occurs and for points within, heteronymous diplopia occurs even though these points are retinally corresponding.



Homonymous **Heteronymous**

Fig. 10

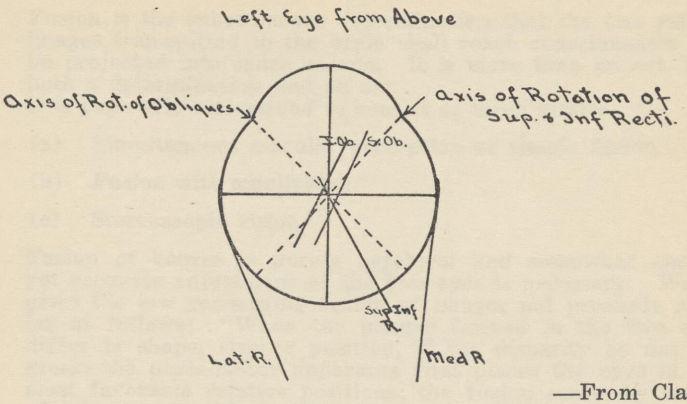
This diplopia has been called "physiologic diplopia", yet we are not ordinarily conscious of it. Both sets of impression reach the cerebrum but are resolved by fusion and assist in orientation. Thus corresponding points are both physical and psychical.

6. External Muscular Action: Before fusion can occur, the globes must be rotated to the most favorable position. This results from rotation about three axes all of which pass through the center of rotation of the globe itself.

(a) The Vertical.

(b) The Transverse.

(c) The Oblique.



—From Clarke

Fig. 11

(d) Listing's Law: "When the line of fixation passes from its primary to any other position, it is as if the eye had arrived at this position by turning around an axis perpendicular to a plane containing the first and second positions of the line of fixation." This simply means that the eye reaches its new oblique position by turning along a plane common to its original and its new position. This is remarkable since three muscles at least are necessary for oblique rotation, not one of them acting alone would turn the eye in the required manner.

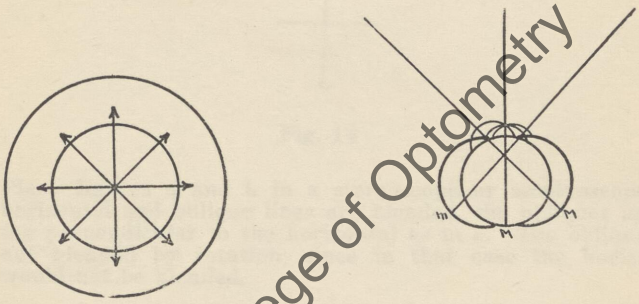


Fig. 12

(e) Torsion is rotation of the eyeball about its own fixation line.
True voluntary torsion cannot occur for the reason that action of any muscle causes the macula to move contrary to the corneal vertex. On rotation about an oblique axis, however, false involuntary torsion occurs, for the vertical meridian of the eye is then no longer perpendicular to the plane of the horizon.

(f) The individual and combined muscular action is so well known that it will not be considered here. The doctrine of "reciprocal innervation" should be understood, however, "When a muscle contracts its antagonist relaxes."

7. Fusion is the subconscious determination that the two retinal images transmitted to the brain shall reach consciousness and be projected into space as one. It is more than an act, it is both a determination and an act.
It is popularly understood to consist of three grades:

(a) Simultaneous macular perception or simple fusion.

(b) Fusion with amplitude.

(c) Stereoscopic vision.

Fusion of course is purely psychical and somewhat elastic, yet accurate adjustment of the two eyes is necessary. Worth gives the law concerning fusion of images not precisely similar as follows: "When the images formed in the two eyes differ in shape, size or position, if the disparity be not too great, the oculo-motor apparatus first places the eyes in the most favorable relative positions; the fusion sense, by virtue of its elasticity, then fills up any gap which may remain." The following experiment suggested by Dr. Verhoeff serves to illustrate this:

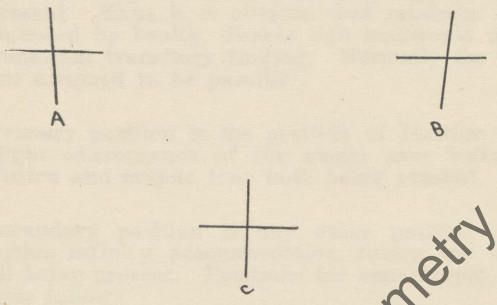


Fig. 14

Place figures **a** and **b** in a stereoscope or amblyoscope, the horizontal and oblique lines are blended, the obliques appearing perpendicular to the horizontal as in **c**. The obliques are not blended by rotation, since in that case the horizontals would not be blended.

8. Types of binocular vision: If binocular vision occurs at all, it must be in one of three ways:

(a) Single and simultaneous.

(b) Double vision.

(c) Alternating vision.

An important factor is the intensity or stability of fusion. It is easily tested by directing the patient's attention toward a white light and suddenly placing a red glass over one eye, diplopia promptly occurs and as promptly subsides, if fusion is stable, otherwise diplopia (white and red lights) remains as long as the red glass is up.

9. Behavior of the visual axes.

(a) We recognize four positions of the visual axes.

(1) Position of rest, true.

(2) Position of rest, clinical.

(3) Primary position.

(4) Secondary position.

(b) The true position of rest is never obtained clinically and occurs only in sleep, under anesthesia, etc. It depends on complete abolishment of fusion and muscle tone. It is usually one of extreme divergence.

(c) Clinical position of rest is the position the visual axes assume when fusion is destroyed and muscle tone is present. Thus it is obvious that muscular tone is influenced by health, disease and ametropia making it a somewhat transitory finding. Normally the visual axes are assumed to be parallel .

(d) Primary position is the position of fixation at infinity, slight convergence of the visual axes being required. Fusion and muscle tone both being present.

(e) Secondary position is any other position of fixation within infinity, accommodation, fusion and muscle tone all being present. Positions for emmetropic orthophoric eyes follow:

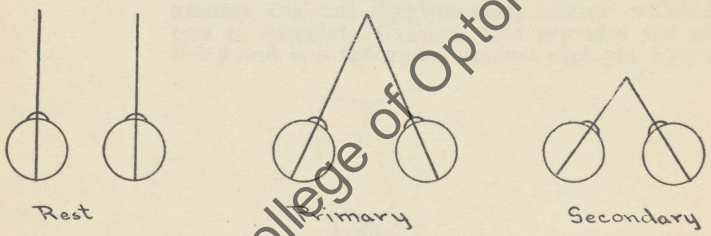


Fig. 15

It is obvious then, that clinical orthophoria is slight esophoria and orthophoria is clinically exophoria.

(f) Convergence must then play an increasing part in all fixation movements originating from the position of rest. Convergence consists of three components.

(1) Initial fusion: To move the visual axes from rest to primary position. Fig. 16.

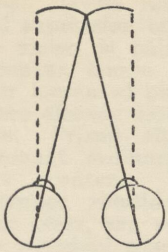


Fig 16

(2) Accommodative Supplement: Resulting from accommodative action in moving the visual lines from the primary to the secondary position. Fig. 17.

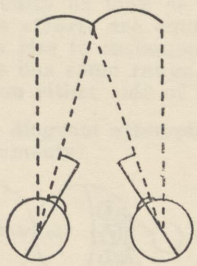


Fig 17

(3) It is not sufficient to provide complete fixation (Physiologic Exophoria) without the help of the positive fusional supplementary center, which enters to complete fixation; this provides for elasticity and is a safeguard against diplopia. Fig. 18.

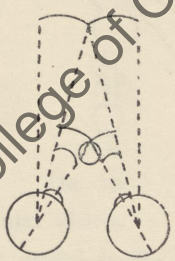


Fig. 18

The function of the fusion supplement is to augment or decrease convergence, as required under different conditions. Any alteration of the previously existing relation between accommodation and convergence is compensated by this center if

possible. If its range is exceeded, diplopia or mental supression occurs, if nearly exceeded, binocular vision is painful. One should remember that convex lenses decrease accommodation and call for increased positive fusion unless over-convergence already exists. Minus lenses do just the reverse. Prisms alter convergence by changing the amount ordinarily supplied by the fusional reserve center. Tests, based on normal convergence relations, to determine the proper reading glass, are very apt to be erroneous due to the pseudophorias produced before fusion has a chance to readjust itself, or due to the changed accommodative relation. Usually a few days later these abnormal conditions will have disappeared. In short one may say, the fusion supplement is the elastic element in convergence. It prevents diplopia by supplying different amounts to meet changed conditions. The amount produced causes no difficulty as long as convergence and accommodative **efforts** are equal. Unequal efforts usually give rise to asthenopia. Accommodation also probably has some range of inequality in viewing objects on either side of the median line.

(g) The following diagram attempts to show the complexity of visual movements:

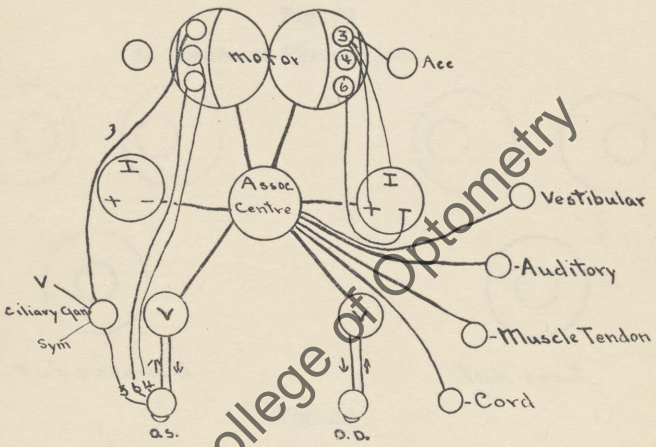


Fig. 19

(h) Tests for binocular vision.

(1) The most useful is the corneal image test which will be given in the section on Diagnosis.

(2) The Amblyoscope: Set the tubes parallel, blending of the images will occur if single simultaneous binocular vision is present. Some movement of the tubes without diplopia is also possible. The type of fusion present is also indicated in this test by varying the targets.

a. Simple macular fixation.

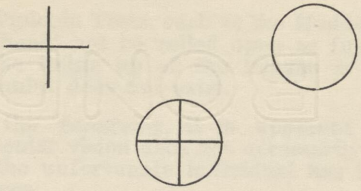


Fig. 20

b. Fusion with Amplitude.

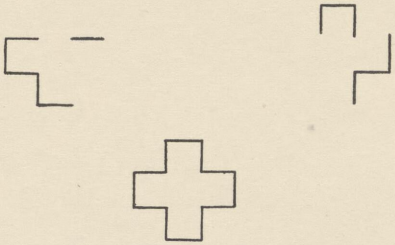


Fig. 21

c. Sense of Perspective.

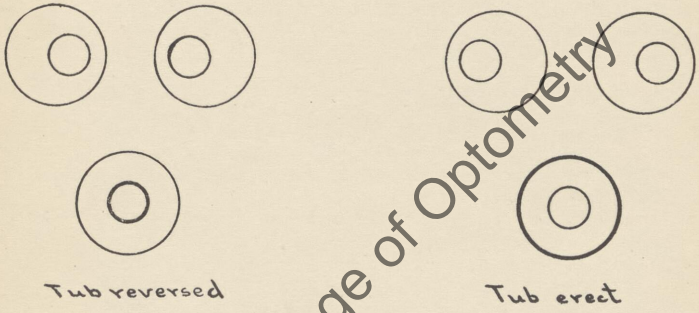


Fig. 22

(3) The Stereoscope: This is easily made by placing two plus five punktals with five to seven prism dioptries, Base out in the phorometer, placing a card between the eyes and using a suitable test card eight inches from the lenses. This is not an absolute test due to the use of prisms but is usually satisfactory—it does not work so well with children under seven years of age. Using the Haitz charts in connection, it makes an excellent test for small central scotomata.

(4) Modifications of the Friend Test: The use of a red glass over one eye and a green glass over the

other, with a red, green and white target, is also very satisfactory.

(5) Diplopia Tests, such as the Maddox rod, prism, etc., should not be relied upon as fusion is absent and the lining up of the images is no criterion that squint does not exist.

From the foregoing, it is apparent that restoration of binocular vision does not necessarily occur, simply because the unfortunate individual has been given a pair of glasses.

END OF SECTION II.

SECTION III.

Etiology

1. Any cause which disturbs the muscular equilibrium may be the starting point of a squint. Not forgetting, that excluding the fusion faculty, the only difference between latent and real squint is one of degree. Muscular insufficiency is a possible cause.

2. Causes of Concomitant Convergent Squint: It is interesting to read the opinions of various outstanding writers on the causation of this variety of squint. One is struck by the wide diversity of opinion and the way in which the cases cited respond to the various treatments, thus proving the authors' contentions. However, it must be admitted that treatment today, is similar to the treatment of many decades ago; the amblyoscope is only a modification of the stereoscope, invented by Wheatstone in 1838; Javal advocated continuous monocular occlusion; etc.

   (a) Defects of the fusion faculty: Worth ascribes all squint to this cause, but it would seem to be only one of the several factors necessary. Babies up to several months of age use the eyes separately and often squint. At four to six months this squint disappears as binocular vision becomes established. It is doubtless true that if the fusion instinct is strong, squint will not occur no matter what the ametropia may be, so that a weakness of fusion is probably the first factor in the causes of squint. The writer has personally examined about fifty children under the age of six with hyperopia of two dioptres or more, not one of whom presented manifest squint. The ametropia was approximately the same in each eye.

   (b) Ametropia without marked anisometropia: The preceding statement about hyperopic children is proof positive that hyperopia is not the sole cause of squint. Were this true, every young hyperope would squint. That accommodation exerts a marked influence on convergence is readily shown by relaxing or causing exertion of accommodation by means of convex and concave lenses respectively. Convergence is lessened if accommodation is relaxed and vice versa. In some individuals this change is only momentary, in others it persists several days or weeks. In hyperopia, accommodation is used in excess of convergence. A convergent squint develops if he cannot dissociate the two (influence of fusion). He has to choose between indistinct binocular vision or clear monocular vision and he chooses the latter. If fusion is strong, the excessive convergence is restrained and squint does not occur. Soon the squinting eye becomes amblyopic and another barrier towards binocular vision is then set up. This amblyopia is termed amblyopia ex anopsia and should not be confused with congenital amblyopia which is rare.

   (c) Marked Anisometropia: When this is present and the fusion faculty is weak, it results in squint because of the inequality of accommodation and convergence of the two eyes. The writer earlier was inclined to think that

anisometropia alone would cause squint, experience has made necessary a revision of that view. Several hundred cases of high anisometropia have been seen, none of which squinted. It seems probable, however, that anisometropias incline toward uni-ocular squint and equiametropia (or nearly so) toward pseudo alternating squint.

(d) Opacities of the refracting media: These possibly cause a few squints by rotating so that an uninjured portion is used for transmission of light. Juvenile cataract does not seem to produce many squints, probably, because it is nearly always binocular. Anyway these opacities cause only a small number of cases.

(e) Muscular anomalies: Faulty attachment or an under or over developed muscle may possibly play some part, probably because of faulty declination. Declinations were strongly advocated by the late Dr. George Stevens, without, however, convincing very many in the profession.

(f) Influence of Vertical Muscles: Nearly every case of horizontal squint shows some vertical deficiency. Often if the vertical is corrected, the horizontal disappears.

(g) Summary: One may say then, that concomitant convergent squint is usually caused by a weak fusion faculty plus hyperopia with often a slight accompanying vertical deviation. It is obvious that mere correction of the refraction will certainly not be sufficient then, in most cases, to restore or bring about binocular vision unless fusion training is also instituted. Further, that the habit of squinting, once formed, is difficult to break and indeed many times, cannot be broken without the aid of a carefully considered operation. The practitioner should not forget this. He should also remember that the fusion faculty is most susceptible to training before the age of seven years. In pseudo alternating squint, the equality of the ametropia is probably the deciding factor, while anisometropia predisposes toward a uni-ocular squint.

(h) True alternating squint is caused entirely by an absence of the fusion faculty. The ametropia is often slight or absent. The writer has seen six of these cases. The average amount of deviation was three degrees and no trace of fusion could be elicited. There is no known cure for this condition. It is rare and not disfiguring cosmetically, so it is not so serious.

3. Causes of concomitant divergent squint:.

(a) Those due to myopia: Squints due to myopia are usually of large amount. If the myopia is uncorrected, the necessary impulse for convergence must be supplied from the positive fusion center, accommodation being absent. If the center is undeveloped, excessive strain results and painful binocular vision is abandoned, although simple fusion is well developed. For mechanical reasons, excessively long eyes also predispose to diver-

gent squint, but the amount of deviation is usually not marked and turning of the head rather than turning the eye occurs.

(b) Those not due to myopia: In divergent squints not caused by myopia, the fusion faculty is poorly developed or absent altogether. The ametropia is not marked and its correction has no effect on the squint. According to Worth, the only cure is operation. Fortunately these cases are in the minority.

4. Absence of Macular Fixation: The macular area is provided in order to produce preponderance of vision at one point. This excludes the possibility of diversified attention, which of course, would render vision a needlessly complex maneuver. Absence of the macula is rare and when it does occur, of course produces a squint for which there is no cure. In squint cases, the resulting amblyopia has for its end point, the loss of central fixation. This often may be restored. Small central scotoma from various pathological causes may also be instrumental in producing a squint.

END OF SECTION III.

SECTION IV.

Diagnosis and Investigation of Squint

1. Inspection: Most squints, except those of low degree, are readily recognized by inspection. One must, however, bear in mind the possibility of apparent squint and also the possibility of true alternating squint being present.

2. Rotation: Squint being suspected, the excursions should be investigated. Hold a pencil in front of the eyes and move in each of the four quadrants. Usually in a concomitant squint, full rotation and conjugate movement occur. Convergence is absent. Occasionally, if the squint has persisted a long time, rotation may be somewhat diminished. The field of macular rotation is the one to be investigated but clinically it does not matter if one slips over into the para-central field. Full rotation to differentiate paralysis or marked paresis is the object of the test.

4. Cover test at Six Meters.

   (a) Direct patient's attention to some object at six meters. (Greek Cross, E, whirling target, assistant, etc.)

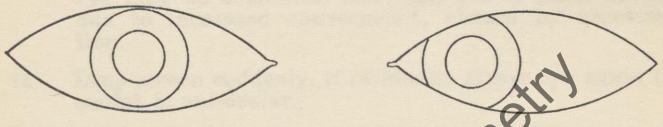


Fig. 23

   (b) Covering fixing eye with screen.

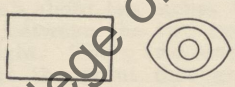


Fig. 24

Originally deviating eye will then fix. If macular fixation is poor the eye will waver, if macular fixation is absent the eye will wander aimlessly about. If a false macula be present, the eye may not move at all. This means that binocular vision of sorts has occurred. The psychic center then interprets the impulses from the deviating eye, as if they were formed on the macula, hence the name "False Macula". That which becomes the function of the brain has been wrongly attributed to the formation of a new macula, which cannot occur.

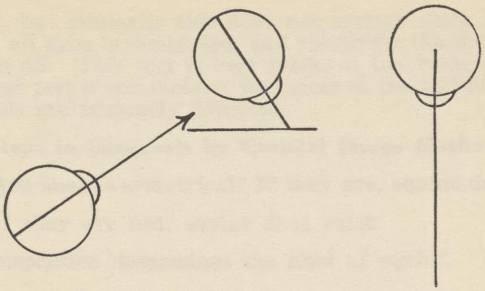


Fig. 25

Now look obliquely behind the screen, the originally fixing eye will be found to be deviating in degrees, the same amount as the original deviation.

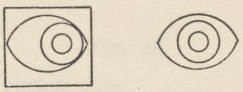


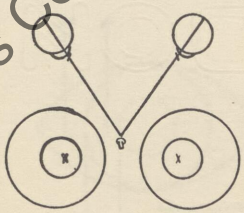
Fig. 26

In case the originally deviating eye has a greater ametropia, the secondary deviation of the originally fixing eye may be somewhat less than the original deviation, due to increased convergence, caused by accommodation.

(c) Drop screen suddenly, if originally fixing eye again fixes, squint is uni-ocular.

(d) If originally deviating eye still fixes, squint is alternating.

5. The Corneal Image Test: This test is by far the most delicate of any, and used in conjunction with the cover test (screen test), affords a rapid means of determining the kind and amount of squint present. It is made by holding the hooded opthalmoscope lamp about ten inches from the eyes on a level with and exactly between the two eyes, and causing the patient to fix the light. Then, two small images are seen, one on each cornea at the point through which the visual line passes. The visual line does not pass exactly thru the point indicated, due to the fact that a caustic curve of reflection is



Normal appearance Corneal Images

Fig. 27

formed, but clinically this does not matter since the error occurs in all eyes investigated, and relatively the deviation is the same in all. This test is best taken at ten inches. Used with the cover test at six meters, variances in the squint at different distances are promptly detected.

Steps in Diagnosis by Corneal Image Method

(a) Are images symetrical? If they are, squint does not exist.

(b) If they are not, squint does exist.

(c) Inspection determines the kind of squint.

Fig. 28

(d) Now cover fixing eye.

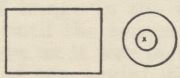


Fig. 29

(e) Drop cover. If originally fixing eye again fixes, squint is uni-ocular, if not it is alternating.

Fig. 30

6. Measurement of Angle: This is done not for operative purposes, but to determine the original deviation and later, the results of treatment.

(a) Hirschberg's method: The amount is approximated by the position of the image of the lamp.

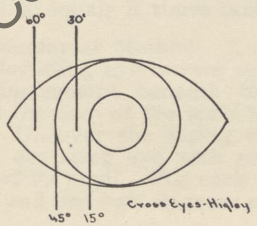


Fig. 31

This method is sufficient for all practical purposes for the average practitioner, but possibly not for the fanatics in our ranks.

(b) The Perimeter method.

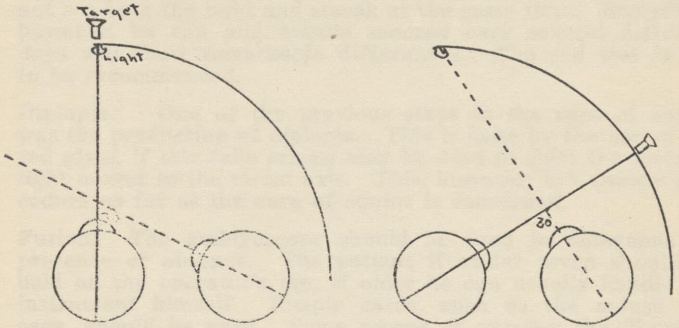


Fig. 32

Have patient fix target placed directly behind light, note the position of image in the fixing eye, then move target along arc until the image is in the same position in the deviating eye as it was in the fixing eye. Then read off the angle of the squint directly from the perimeter arc at the position of target.

(c) The Tangent method: This is the same as the perimet-

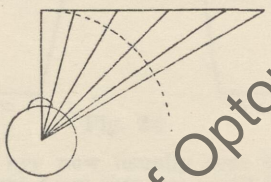


Fig. 33

ric, except that a flat bar is substituted for the perimeter and marked with degrees obtained from the tangent of the angle. Each succeeding space than becomes larger than the preceding as the tangent increases with the angle. The size of each space is found from the formula X equals R times tangent of angle.

(d) The Strabismometer Method: Cover the fixing eye and direct the deviating eye toward some distant point. Then place the instrument beneath the originally deviating eye, so that the zero of the scale is beneath the center of the pupil. Uncover the fixing eye and note the position of the deviating eye with respect to the scale and the center of its pupil. For each millimeter of deviation about four and one-half degrees of squint is present.

Central Scotoma: Occasionally a small central scotoma (less than 1-2°) causes amblyopia and resultant squint. If the pa-

tient is old enough a Haitz chart with one red center and the stereoscope is used. If central scotoma is present, the optical treatment is contraindicated and the child should be referred to a physician.

8. The Rod Test: This is not satisfactory since the patient cannot see both the light and streak at the same time. Sometimes however, he can and results secured over several different days will show remarkable differences. The rod test is not to be recommended.

9. Diplopia: One of the previous steps in the cure of squint was the production of diplopia. This is done by the use of the red glass, if this fails prisms may be used to shift the incident light nearer to the visual axis. This, however, is a useless procedure as far as the cure of squint is concerned.

10. Fusion: The amblyoscope should be used to determine its presence or absence. The patient if under seven should be held on the operator's lap, if older he can usually handle the instrument himself. Simple cards, such as the mouse and cage, should be used. Some means of varying the illumination for each tube must be devised. The use of a Crookes Lens over the better eye is of little assistance here. If fusion is absent no amount of treatment will cure the squint and a cosmetic operation is the only possibility.

(a) Adjust the tubes roughly to the angle of the squint. Place lights at some distance from tubes.

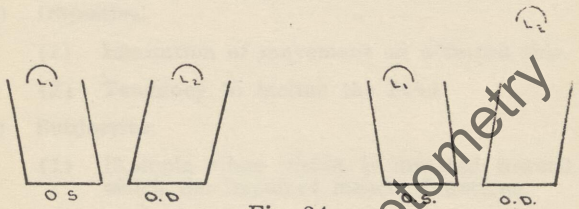


Fig. 34

(b) The fixing eye now usually sees its card. Then withdraw the light from this eye, until the deviating eye sees its card. By varying the light, usually the child will see both, then by moving the tubes, the mouse may be made to go in and out of the cage, etc. Until a careful trial like this has been made, one is not justified in saying that fusion is absent. It usually is not. If it is, treatment is useless. Fusion may be re-established, but it cannot be created.

11. Vertical Squint: This type does not usually occur alone, being associated generally with a lateral squint. The corneal image and screen test shows promptly the type of deviation involved, i. e., simple vertical alone, lateral alone, or a combination of the two. If simple vertical squint, hold vertical

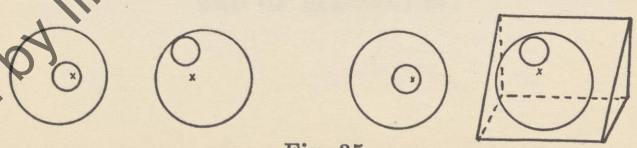


Fig. 35

prisms of varying strength, base up or down, depending upon the direction of the visual axis of the deviating eye, i. e., axis points up, use base down and vice versa. When the simple vertical squint is properly corrected, covering of the fixing eye does not call forth any movement of the eye which originally deviated. If lateral squint is present and has not disappeared upon the application of the prism (the correcting lenses are to be in place), lateral recovery in the cover test will still occur, but the vertical component will have disappeared.

12. Summary of Diagnosis of Squint.

(a) Determine presence of squint by inspection.

(b) Use cover test at six meters.

(c) Use corneal image and cover test at ten inches.

(d) Try effect of vertical prisms on corneal images.

(e) Test for fusion.

(f) If possible eliminate central scotoma (small).

(g) Test conjugate rotation and uni-ocular convergence.

13. Differentiation of Paralytic Squint: Symptoms of ocular paralysis.

(a) Objective.

(1) Limitation of movement on affected side.

(2) Tendency to incline the head.

(b) Subjective.

(1) Diplopia when vision is directed toward area in which the impaired muscle functions.

(2) Diplopia varies in amount.

(3) Vertigo, nausea, headache, faulty orientation and uncertain gait.

(c) The differentiation may usually be based on the following three points:

Paralytic Squint	Concomitant Squint
1. Contraction of Visual Field	1. No Contraction
2. Secondary deviation greater than primary.	2. No Difference
3. Diplopia	3. No Diplopia.

END OF SECTION IV.

SECTION V.

Prisms

1. Prisms have no place in the treatment of concomitant squint as will be readily apparent from the preceding etiology. The trouble lies not in the muscles but in the psychic areas of the cortex. Prisms may be used to shift the incident light to the macula for any given distance of object, but their usefulness stops there. The moment the rays turn toward another object, the prism ceases to be correct. Thus they furnish no incentive to fusion, which is vital if a cure is to be expected. All this applies to lateral squint. If the eyes have enough fusion to straighten, when a nearly full prism is applied, there would have been no squint.

   In vertical squint, prisms by their action obviate the vertical component and eliminate the effect of the marked declination of the visual axes. So that prisms should always be used for the vertical element, never for the lateral. As the squint proceeds toward a cure, often the vertical element lessens, but usually not. These cases are rarely straight without glasses. Prisms, outside of the verticals, belong to latent squint, which is not considered in this monograph.

END OF SECTION V.

SECTION VI.

Treatment of Squint

1. The adequate treatment of squint depends upon several factors and the essential steps are as follows:

   (a) Correction of the error of refraction.

   (b) Restoration of the fusion faculty.

   (c) Restoration of vision in the amblyopic eye.

   (d) Readjustment by operation.

2. Time and duration of treatment.

   (a) Under the age of seven: It is unwise to continue treatment after the age of six is reached. If results are not good, give the child the benefit of operation by a competent operator (not a tenotomy expert). If this is not done, fusion becomes increasingly difficult to train.

   (b) Over the age of seven and under fifteen: Treatment should be continued, if results are not rapid, over at least three years.

   (c) Over Fifteen: As a general rule, results are poor after this age. The writer, however, cured one patient, age twenty-four, after five years of treatment. She had, however, worn glasses since the age of four. An old saying is "It will take as long to cure the squint, as the time it has existed." The writer is unable to verify the truth of the statement, but it would seem to be a false one. Squint lasting a long time will probably continue as long as the patient lives.

3. Selection of cases.

   (a) True alternating squint cannot be cured.

   (b) Divergent squints due to causes other than myopia require operation.

   (c) Squints due to opacity or disease (paralytic) require therapeutic attention, and should be referred.

   (d) This leaves then:

      (1) Concomitant convergent squint.

      (2) Myopic divergent squint.

      Of the two the latter is the more easy to treat, due to the fact that it develops usually after the fusion faculty has been used for some time.

      a. Correct the refraction using bifocals if the myopia is 5 D., or over.

      b. Use Gilbert's monocular occlusion and Snellen test type exercise if lessened vision is present in either eye. This method is described later.

4. Retinoscopy: It is obvious that in children under nine or ten we must rely on the retinoscope. For children the writer does not now use orthodox dynamic skiametry. Too many times overcorrection results. This method is useful in high esophoria and for the detection of small cylinders. It does not give the latent error as the writer has many times demonstrated by comparing dynamic with cycloplegic results, if cycloplegia gives the true latent error.

(a) Fixation and observation at different points.

(1) Fixation at 26″ equals 1.5 D.

(2) The target of letters is moved toward the eye until the reflex reverses. The figure will make the method clear. This is the qualitative test.

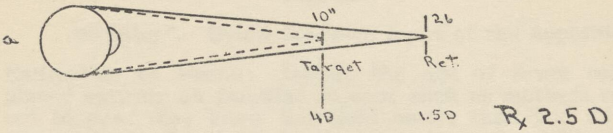


Fig. 36

(b) Observation and fixation at same point:

One eye is occluded, the eye under test usually shows a slight with motion. Add plus lenses until reversal occurs, subtract +.25D., and the result is the Rx given to children. This method is used up to the age of nine, after that age the regular routine examination is used. This is the quantitive test.

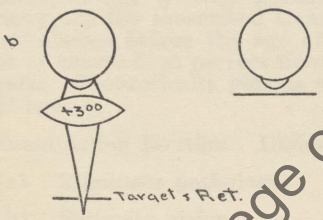


Fig. 37

Operators using trial case only will display judgment if they refrain from accepting squint cases.

(c) Static Retinoscopy: This is a useful check, the fact that it generally indicates an under correction mitigates somewhat against it. Since writing this paper, the author has had presented to him a little fixation device. It consists of a moveable figure, operated by means of a rubber bulb. This device holds the attention of the child and by having him work it rapidly undoubtedly aids in the relaxation of the ciliary muscle as shown by the dilatation of the pupil. Those interested in this little device can obtain full information, by writing the

Fig. 38

inventor*. Below is shown a cut of the apparatus.

5. Estimation of Vision: Before the age of seven reliance is placed entirely on familiar objects, such as mothers can point out to you; they know the child better than you do. From seven to nine Landolt's broken ring is used. After nine the regular test objects. The ivory balls have been tried with poor success by the writer. Special targets with familiar figures are usually not any more accurate than the other methods.

6. Ophthalmometer: The writer uses this instrument on every patient, even the babies who are held on their mother's lap. Good results are obtained in over half the cases under six years of age.

7. Age to Begin Treatment: One should accept patients of three years of age if their parents are intelligent and willing to carry out the prescribed treatment. Nothing is gained by using glasses before the age of three. If the reader thinks so, he of course is at perfect liberty to attach glasses to a suckling babe. Theoretically glasses should be used before six months of age.

8. Examination Routine: Under age nine.

   (a) Eliminate pathology.

   (b) Estimate vision.

   (c) Use Ophthalmometer.

   (d) Retinoscopy.

      (1) Fixation and observation at different points.

      (2) Fixation and observation at same point.

      (3) Subjective retinoscopy.

9. Treatment: First month—Wear correction continuously. (.50 D. too tsrong over fixing eye). If squint is still present at end of one month, proceed to: Second month—Occlude fixing eye continuously for one week, then fixing and deviating eye,

* W. J. Henry, Orpheum Arcade, Akron, Ohio.

alternating a day at a time for one week, then fixing eye continuously for ten days, then occlude neither for three days, then re-examine. Vision should now be somewhat improved. Then occlude fixing eye all first day; then until an hour before bedtime second day; and then one hour less each day. Then when no bandage has been worn for three days re-examine. Now start fusion exercise with amblyoscope twice a week for eight weeks. Bandage fixing eye only at meal time. Usually the squint has disappeared by this time, at least with glasses. If not the prognosis is poor.

In any event see the patient every three months until distant vision may be accurately checked. The length of time bandaging must be resorted to depends on the improvement of vision. One must not occlude too long at a time since the fixing eye may become amblyopic. Each case must be handled on its results.

If no results are obtained after three months, usually you need not expect any, that is in young squinters. The use of Crookes B over the fixing eye has given poor results for the writer, who prefers overcorrection by 50 D., instead. As long as vision in the fixing eye is best, continue overcorrection. The writer has not used the night bandage advocated by Higley, since he orders continuous occlusion while Higley does not. For **occlusion** several folds of three inch gauze or 4x4, cut in a circle and held in place with adhesive makes an excellent blinder. It need only be changed every three or four days.

The foregoing is in general the treatment used up to nine years of age. After nine and up to fifteen the treatment is the same except the patient is instructed to use a Snellen test card. The card is hung at one end of the room and the patient is to stand as far away as possible and attempt to read the larger letters, he should then advance slowly until all can be read and then retrace his steps until all have disappeared, this should be repeated twice daily. Its use should be persisted in. It fails to get results too often because perseverance is not in the average person's makeup. This is Gilbert's method.

Over fifteen—Occlusion is not resorted to chiefly because the patient objects to it and you are not certain enough of results to force him to wear the blinder. Gilbert's method is resorted to and should be kept up for several years. The amblyoscope should be used, but is usually of little value. If the squint can be made periodic, prismatic exercise, rythmic and shock with relieving prisms for constant wear, weakened monthly, plus fusion exercise may sometimes bring about a cure. Experience, however shows that very little is usually accomplished after childhood.

10. Operation.—All cases which do not improve may be given the benefit of a cosmetic operation. If vision is good in either eye, diplopia usually results which proves troublesome but usually disappears (vision lessens also). If our treatment fails, the patient should have the benefit of the doubt. The opinion of a good surgeon should be sought. We should not advise against operation for it is a procedure most optometrists know nothing about.